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FLAXER

(54) **HUMIDIFYING UNIT FOR A HVAC SYSTEM**

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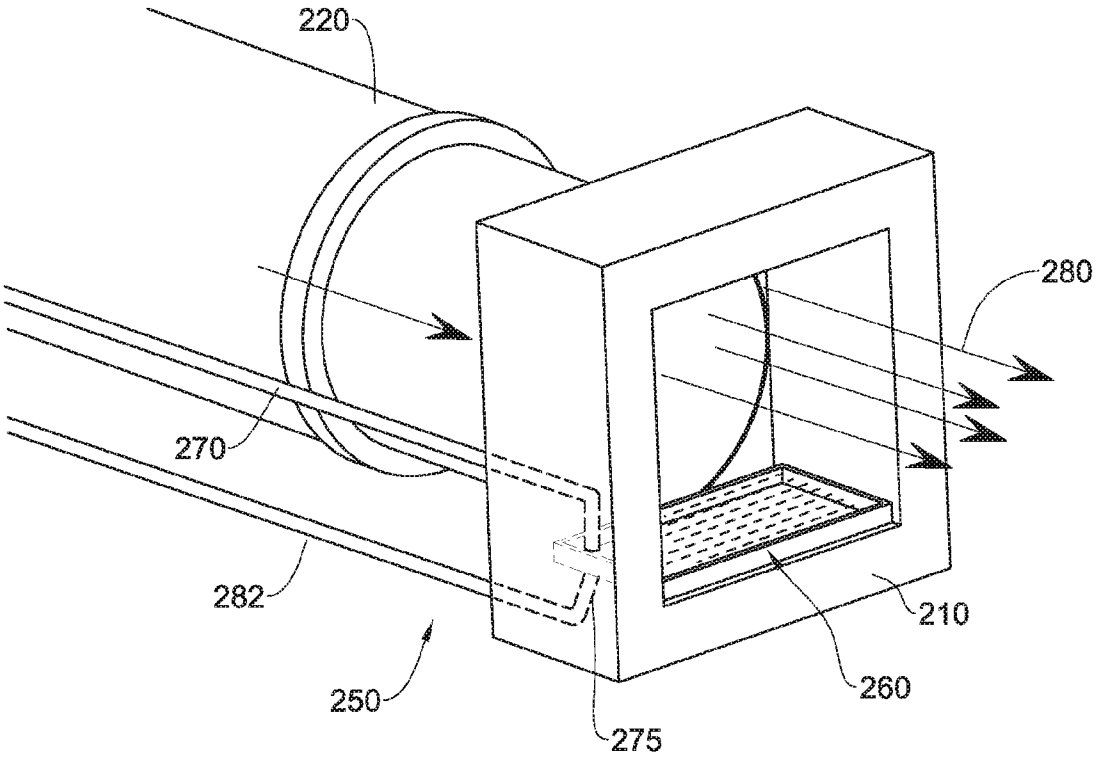
(57) **ABSTRACT**

A Heating Ventilation and Air Conditioning system is provided having airways configured to direct airflow towards a confined area, the system including a humidifying unit having a tray disposed in the airways and configured to hold water therein, the tray is so disposed in said airways such that the water humidifies the airflow in said airways controlling thereby the humidity level in the confined area.



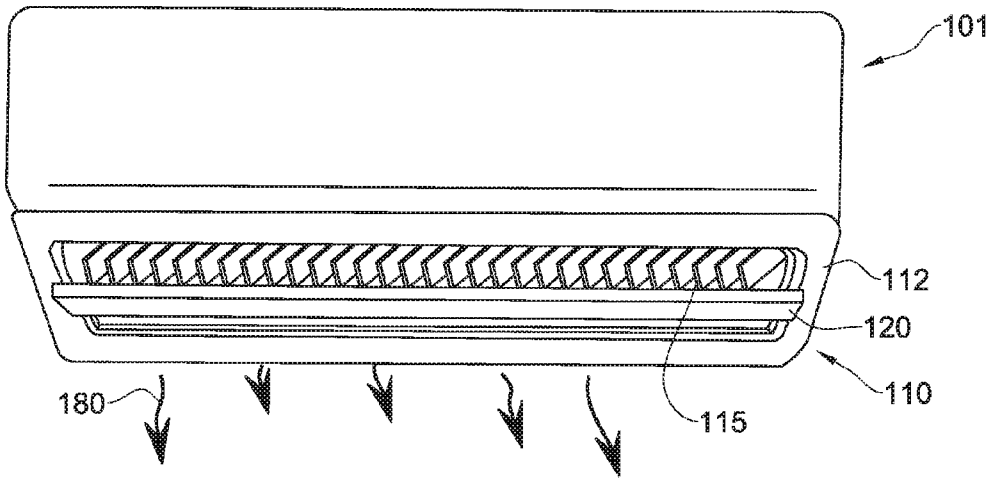


Fig. 1A

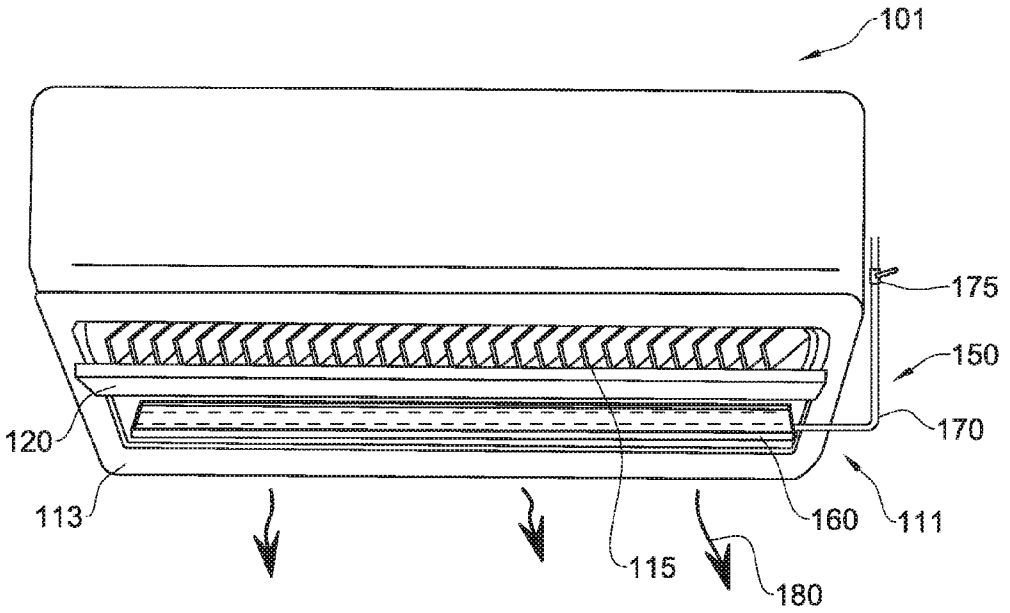


Fig. 1B

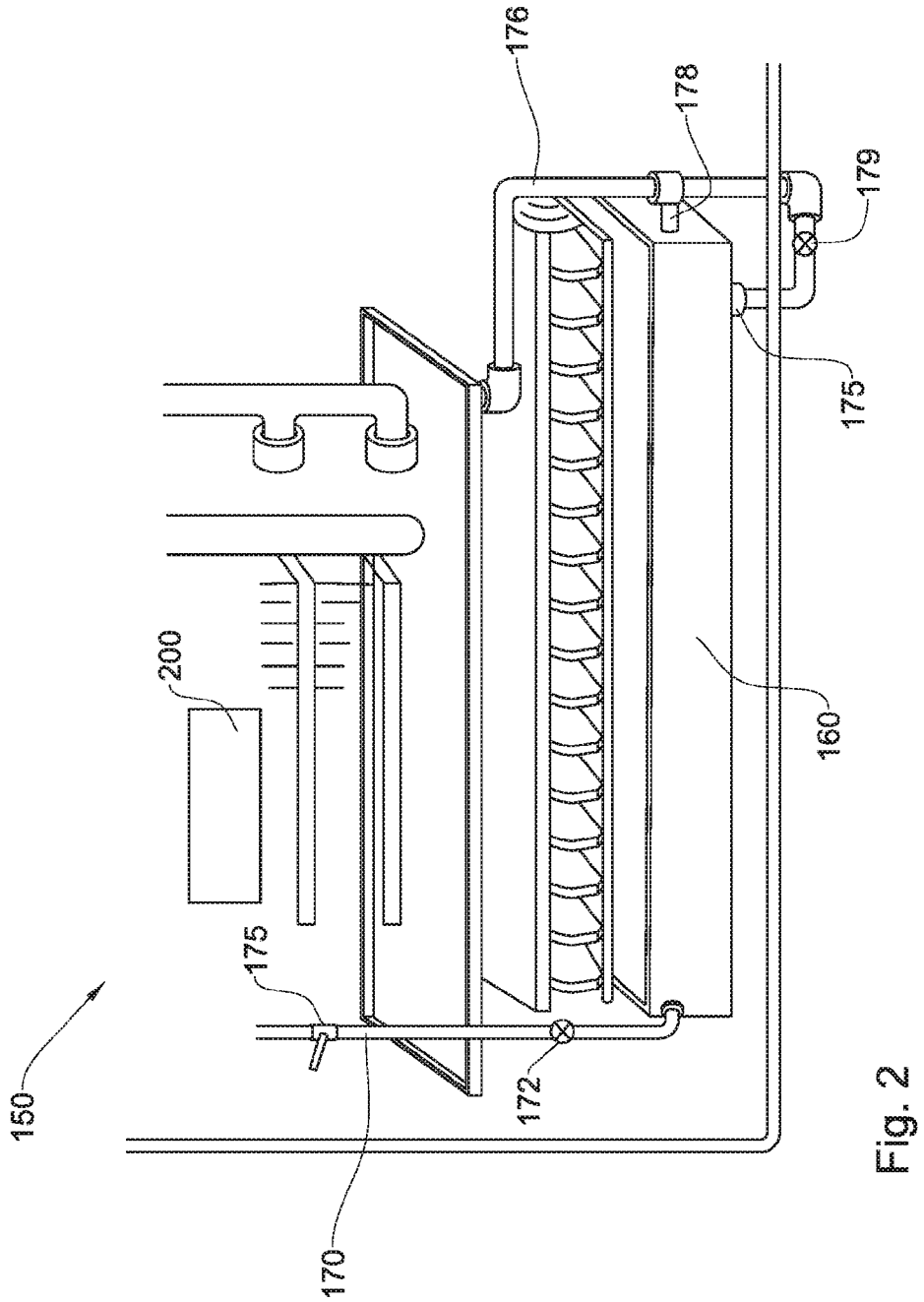


Fig. 2

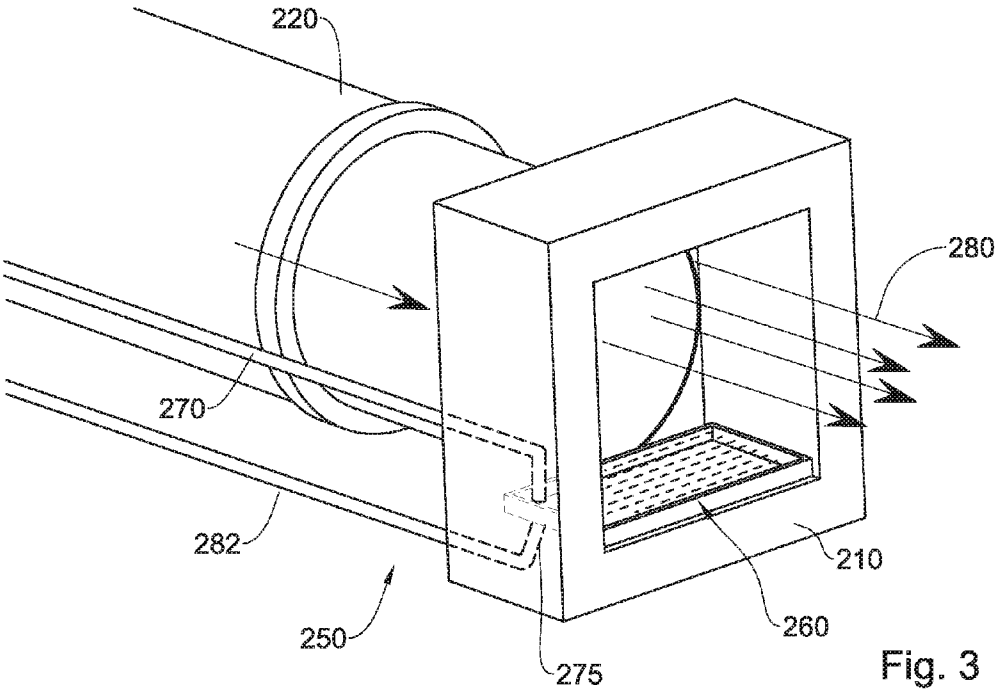

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Fig. 3

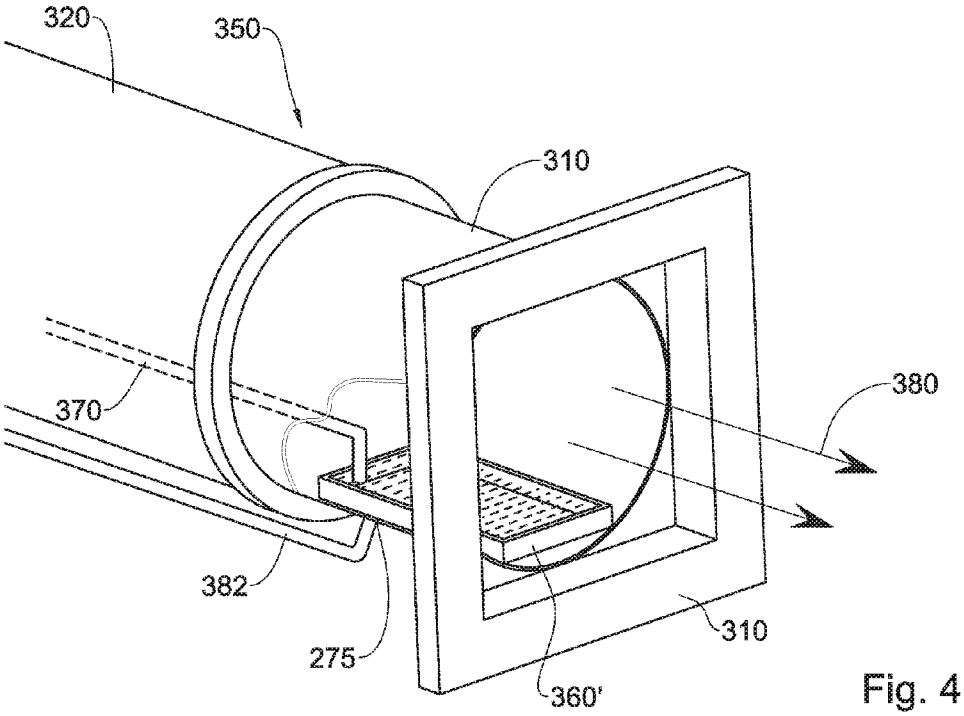
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Fig. 4

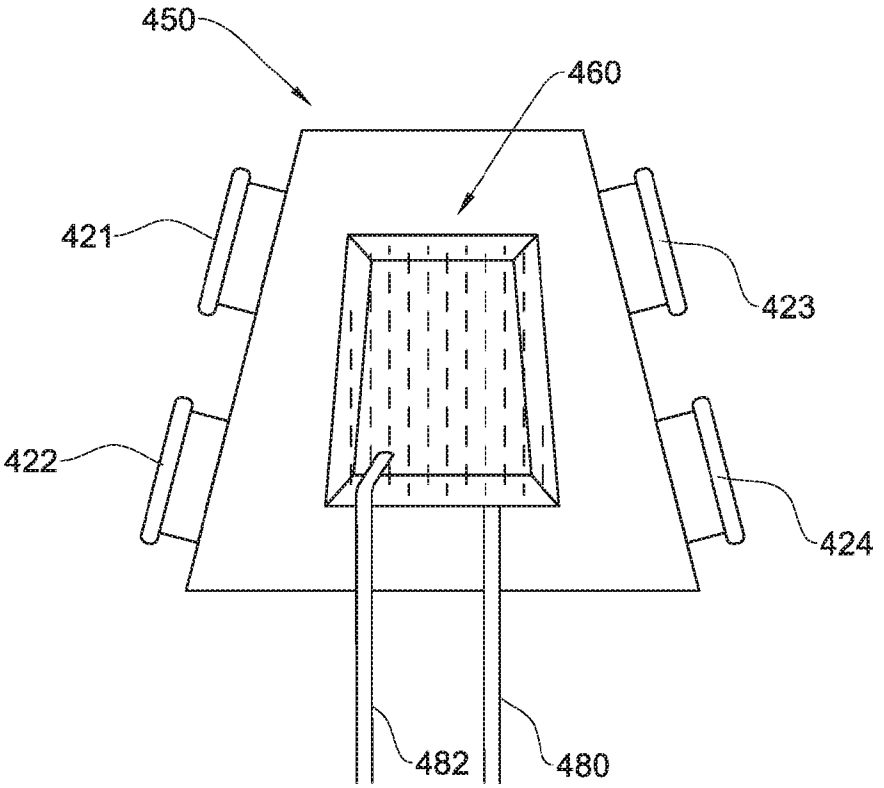

Fig. 5

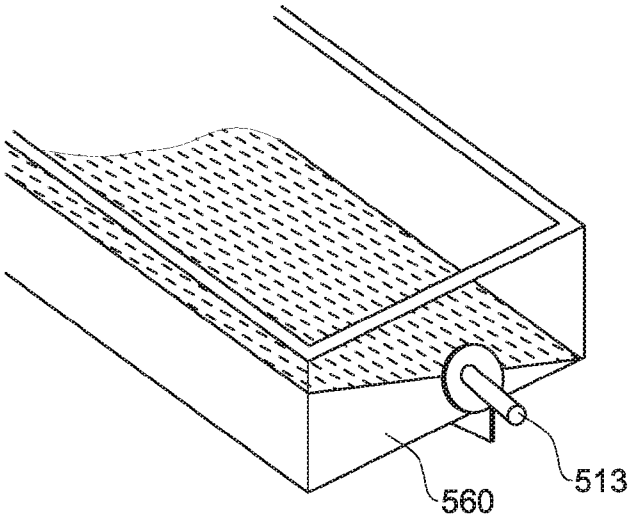

Fig. 8

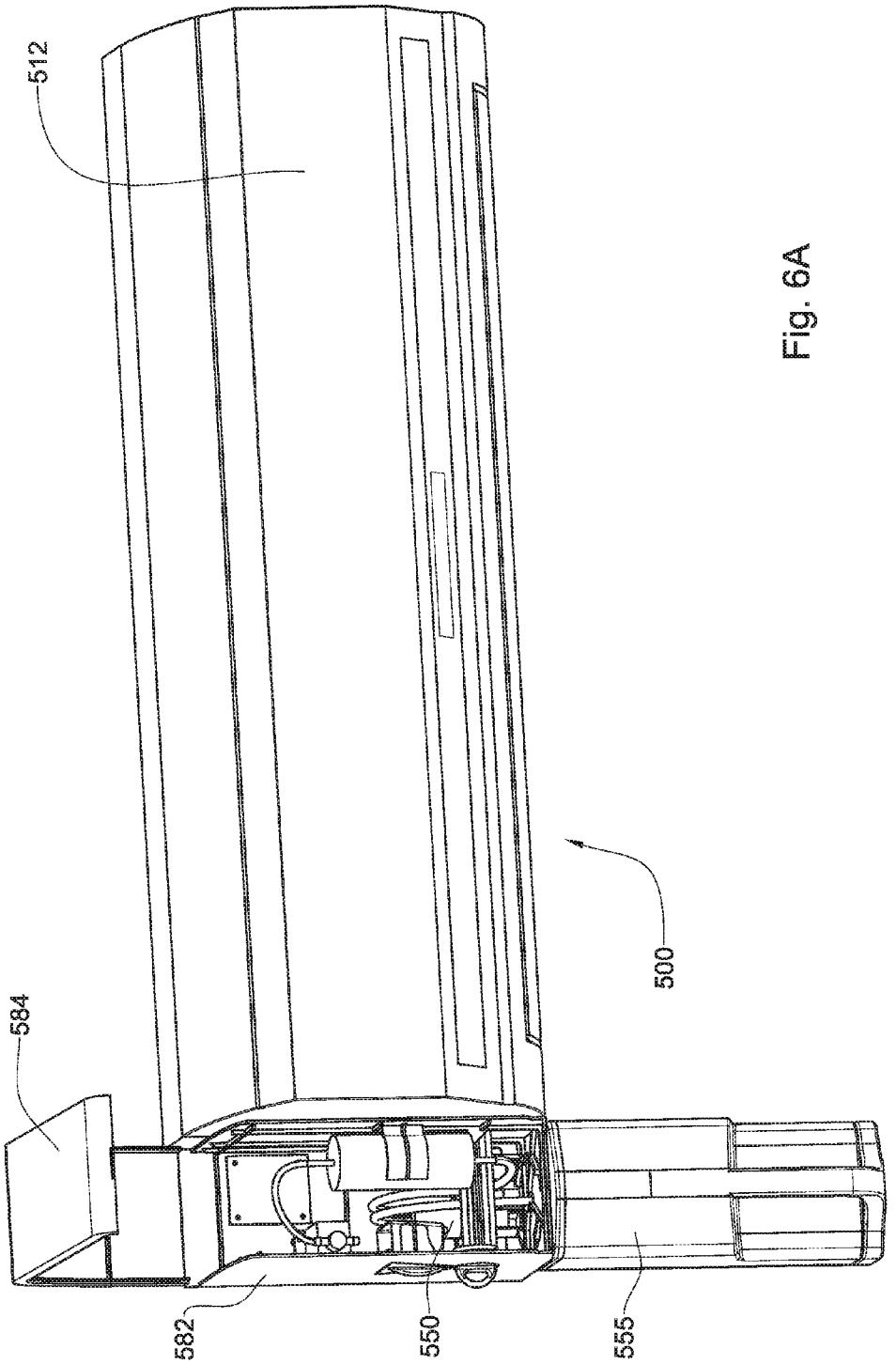

Fig. 6A

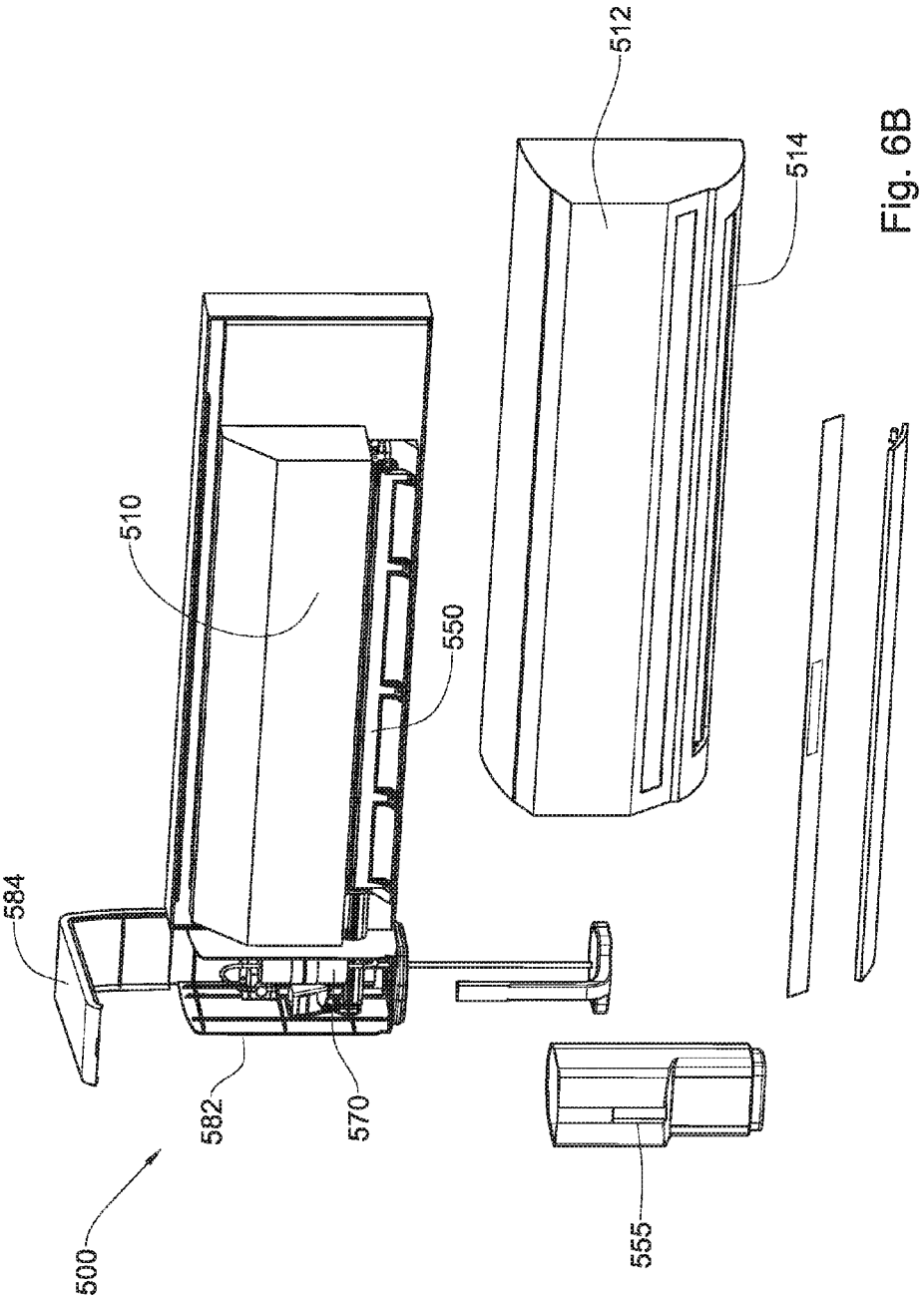

Fig. 6B

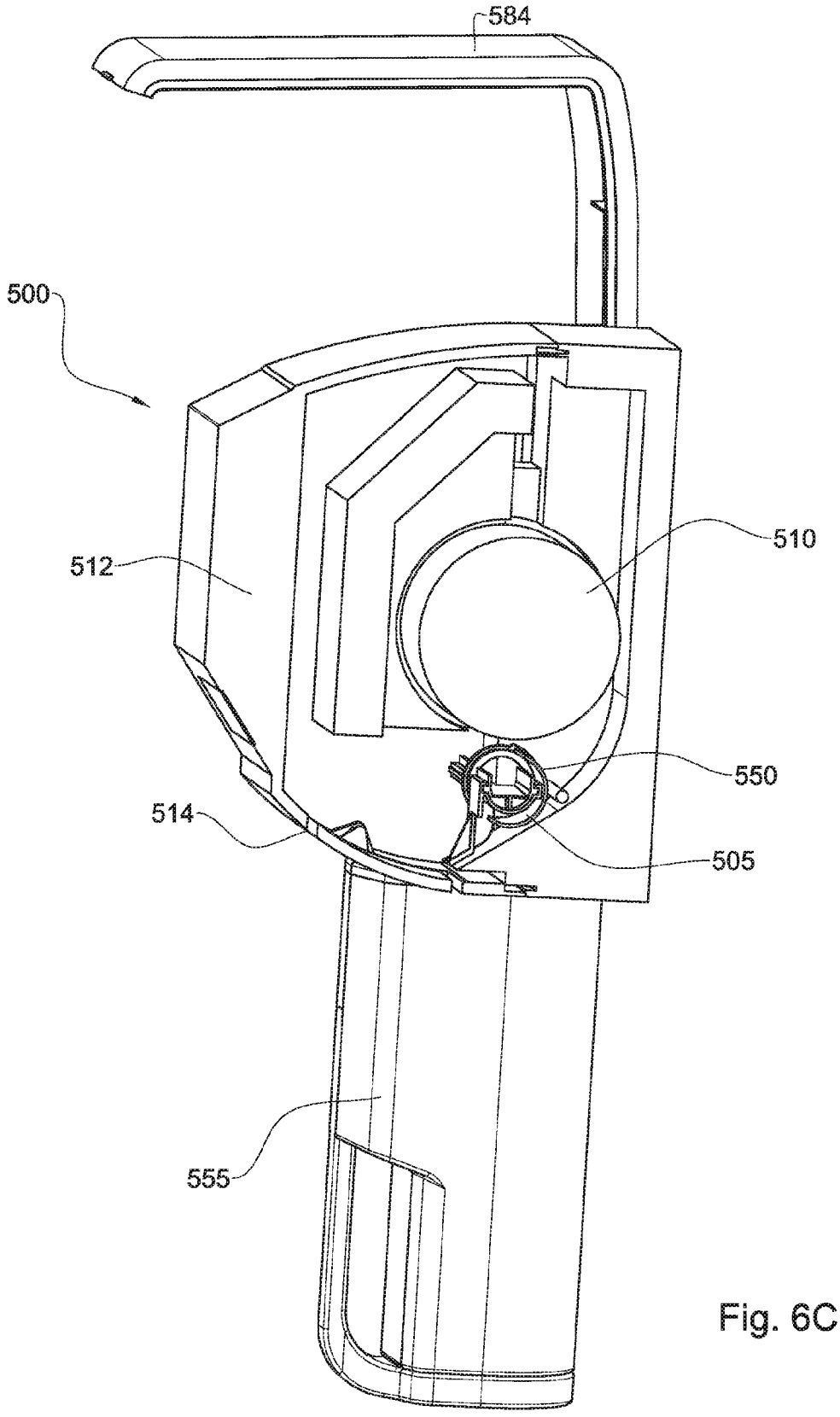

Fig. 6C

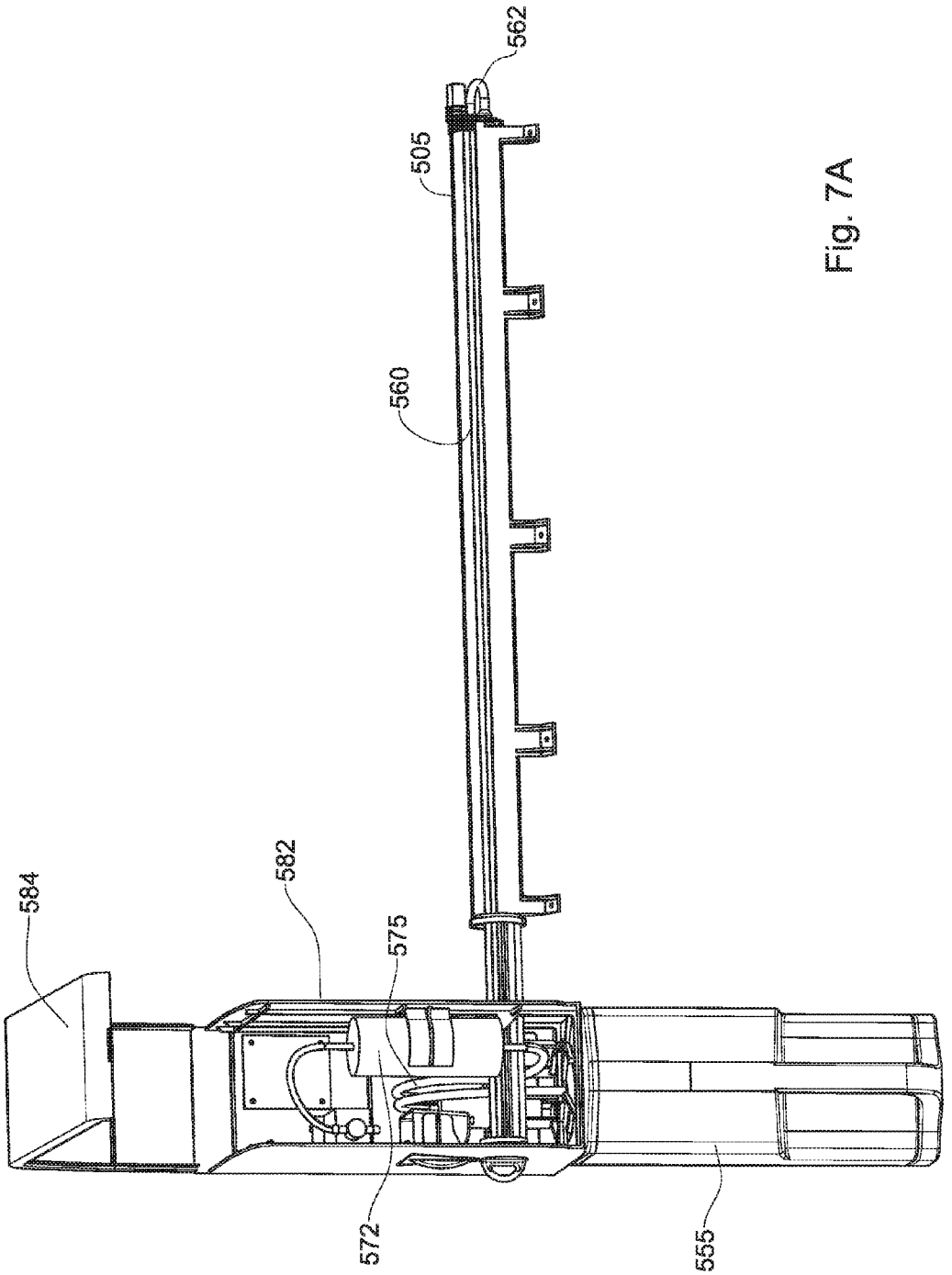

Fig. 7A

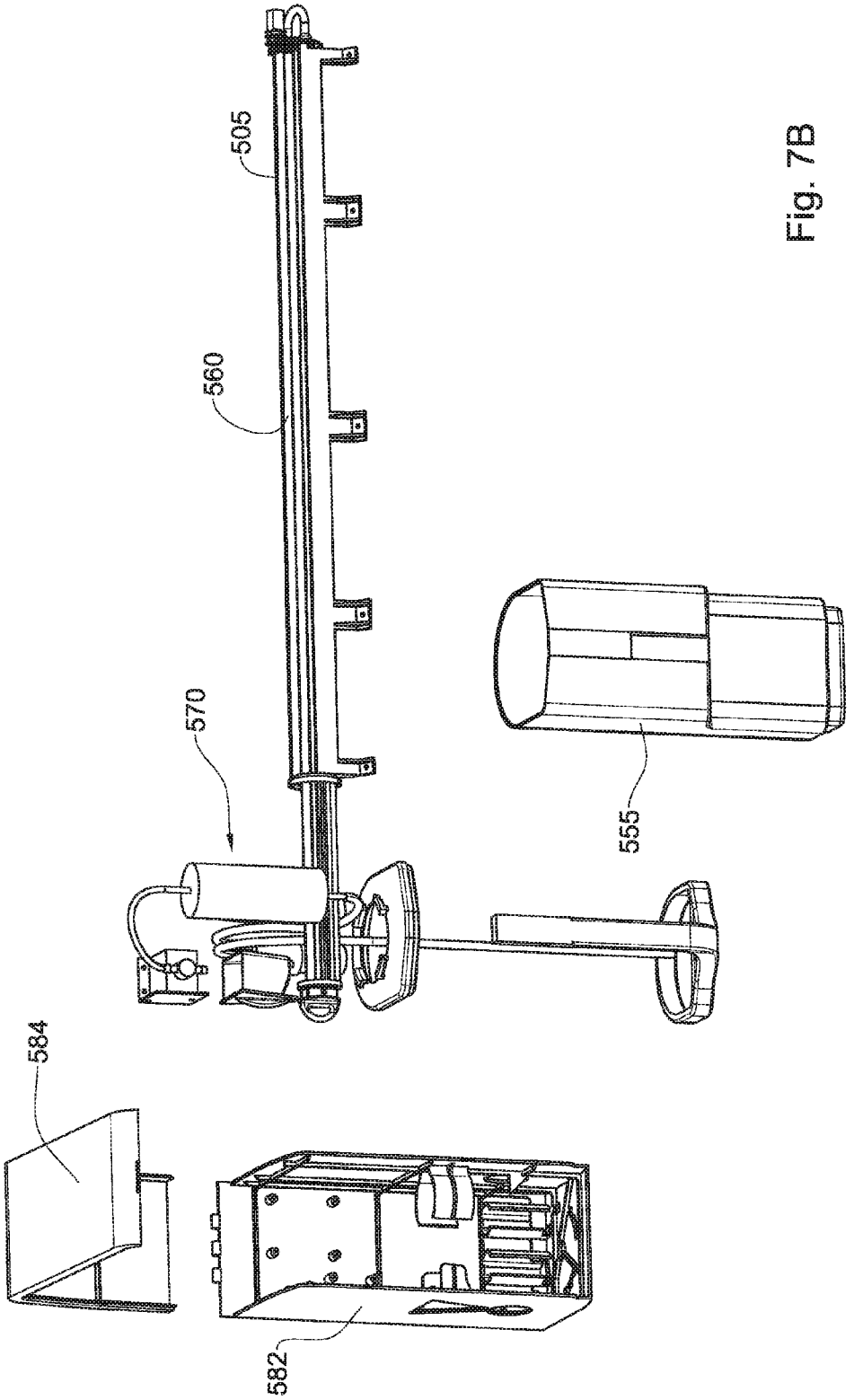

Fig. 7B

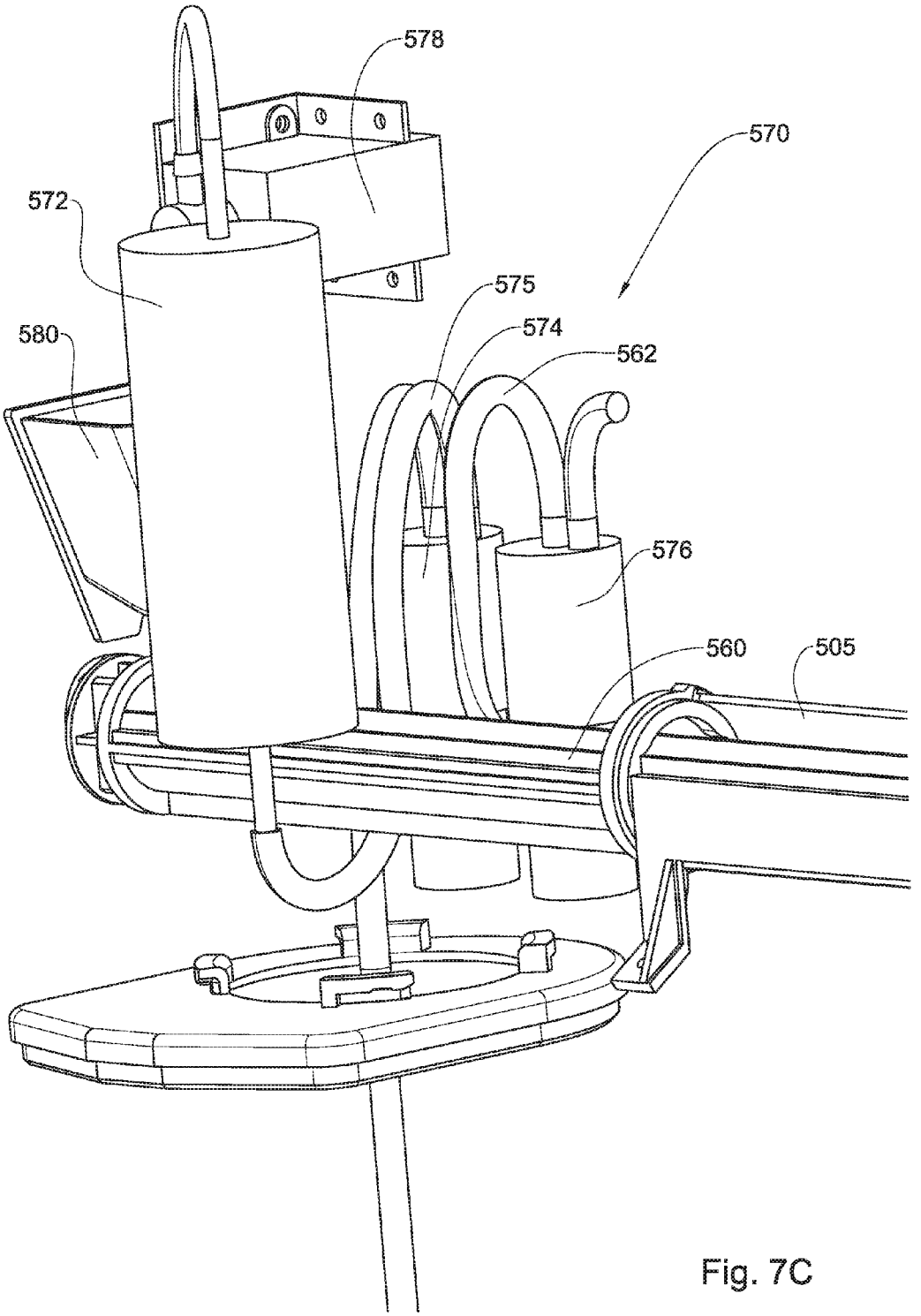

Fig. 7C

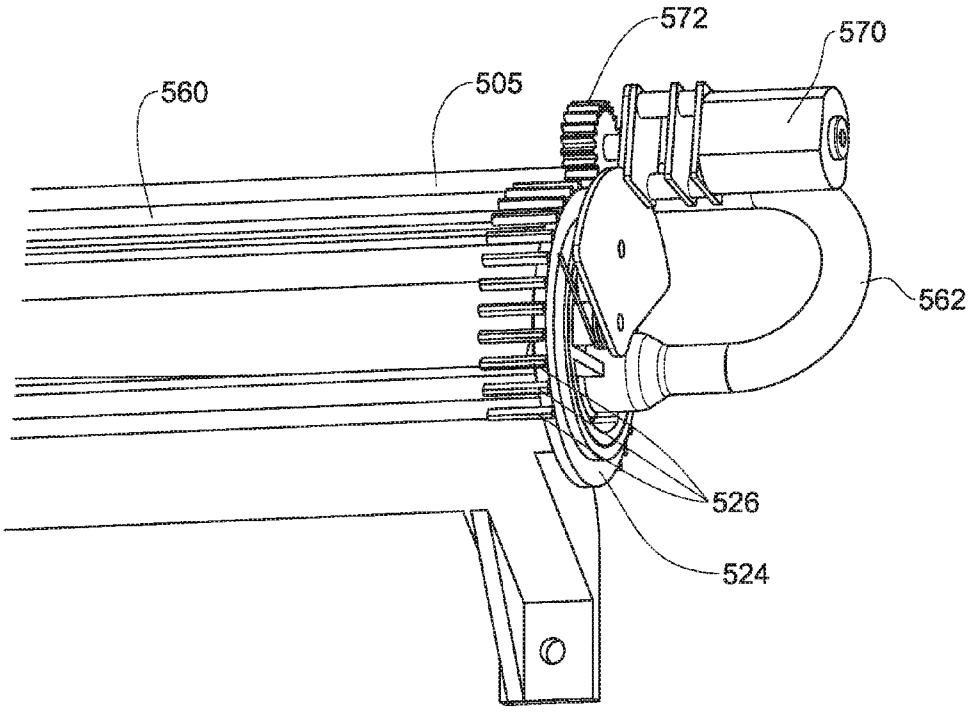

Fig. 7D

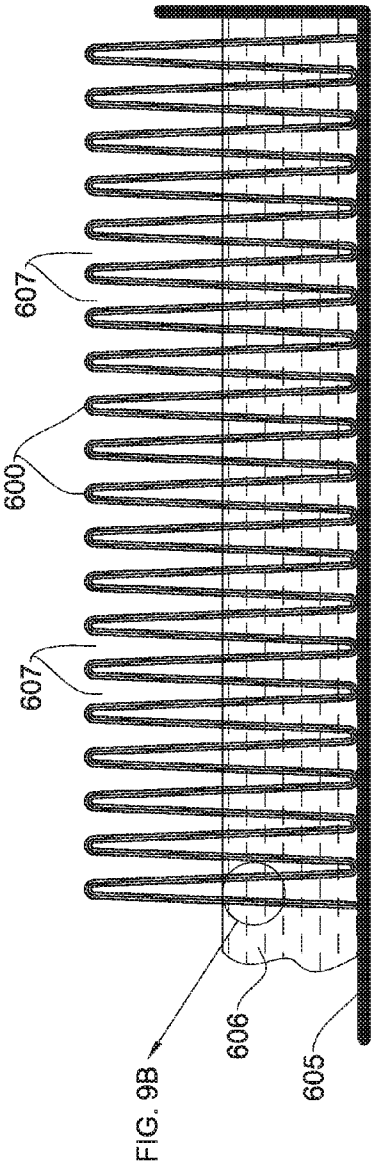

Fig. 9A

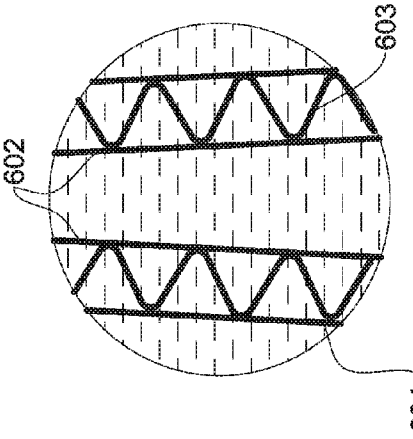

Fig. 9B

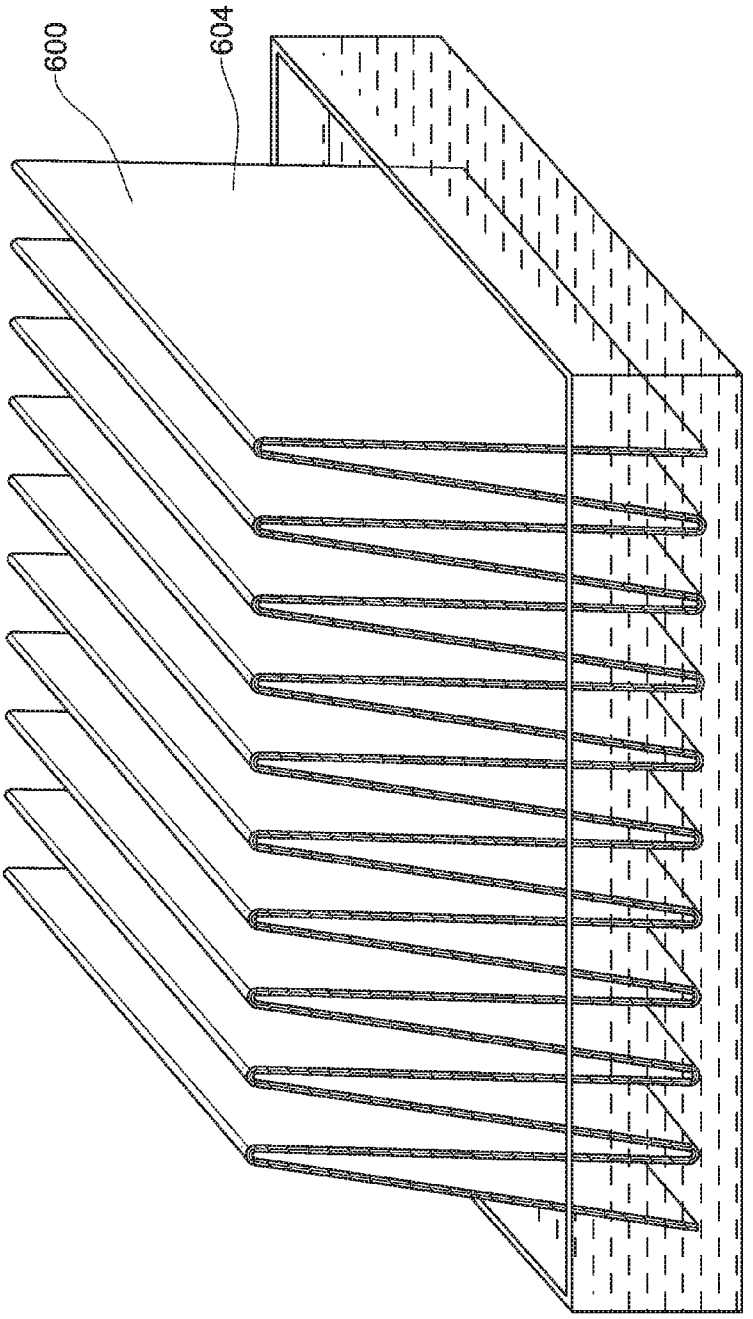

Fig. 9C

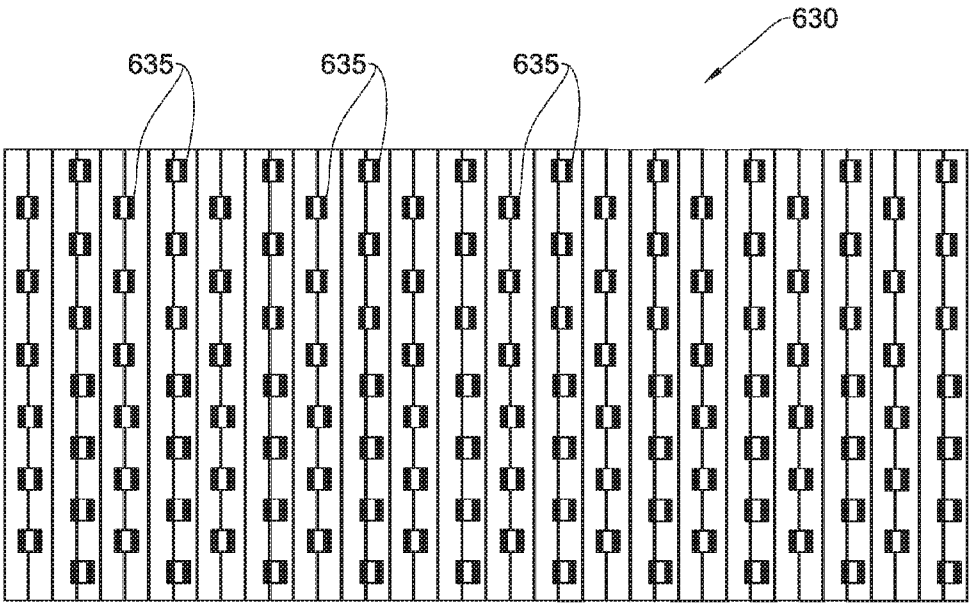

Fig. 10A

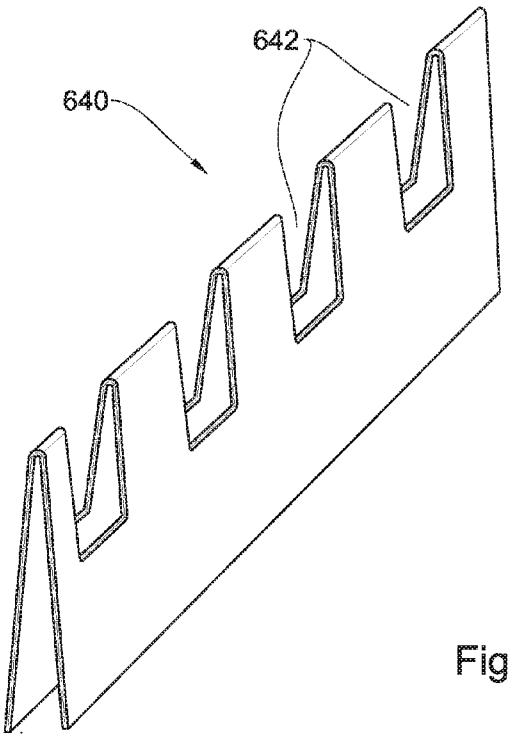

Fig. 10B

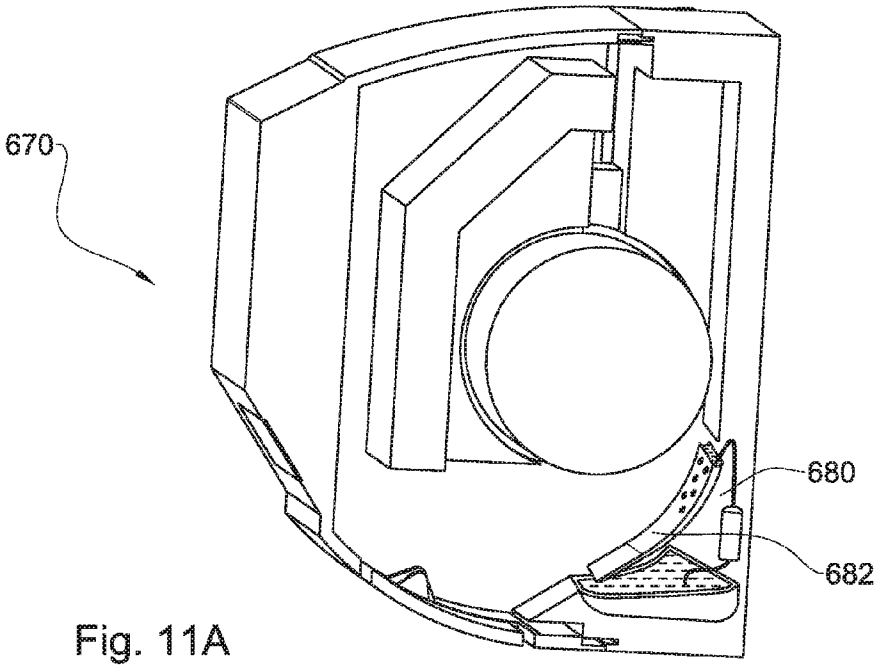

Fig. 11A

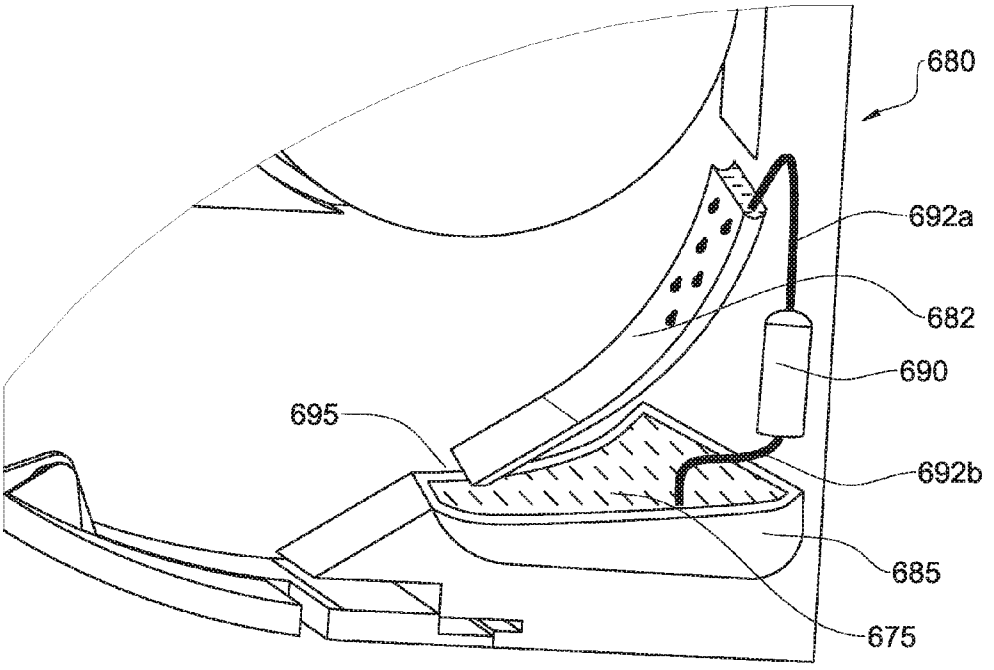

Fig. 11B

HUMIDIFYING UNIT FOR A HVAC SYSTEM

TECHNOLOGICAL FIELD

[0001] The presently disclosed subject matter, relates to a humidifying unit in general and in particular to a humidifying unit for a Heating Ventilation and Air Conditioning (hereinafter HVAC).

BACKGROUND

[0002] The presently disclosed subject matter, in some examples thereof, relates to a humidifying unit for a Heating Ventilation and Air Conditioning (HVAC) system and, more particularly, but not exclusively, to a humidifying unit that is operable to be retrofit on existing HVAC systems.

[0003] Various humidifiers have been used in the connection with home or commercial heating systems to increase the humidity level of a discharged, heated air stream. A proper humidity level in the air can enhance the comfort level of an occupant in a heated room as the moisture in the air is known to inhibit discomfort associated with undesirable drying of the nasal passages. Furthermore, the increase in air moisture enables the occupant to feel more comfortable at a lower temperature level and thereby can be used to reduce costs associated with heating.

[0004] Evaporative cooling systems that humidify circulated air are also known to be used to augment cooling provided by traditional air circulators. Some known evaporative cooling systems operate with a fluid source in combination with a powered propeller to draw an airstream through a water-soaked filter. Optionally, a separate, stand-alone pumping system is used to supply fluid to augment the cooling provided by a separate air circulator.

[0005] U.S. Pat. No. 3,855,371 entitled "Humidifying Apparatus for Warm Air Ducts and the Like," the content of which is incorporated herein by reference describes an atomizing or spray type humidifier assembly that can be removably mounted in an air conveying duct, such as a main trunk horizontal duct, of a hot air heating system. The humidifier assembly includes a solenoid controlled spray nozzle and a multi-layer screen supported in an elongated tunnel structure of rectangular cross-section having opposite open ends to be removably positioned wholly within the air conveying duct.

[0006] U.S. Pat. No. 4,006,674 entitled "Humidifiers for forced air systems," the content of which is incorporated by reference herein describes a humidifier for use in forced air heating systems. The humidifier includes a housing having a water reservoir adapted to be positioned adjacent an air register, outlet or diffuser. A duct in communication with the air register is provided within the housing for delivery of air to the water reservoir, and a flexible curtain or baffle is positioned within the housing across said duct and extending into the water of said reservoir. The arrangement requires the forced air entering the duct to flex, balloon or bow out the curtain to raise it above the water surface in order to escape to the outside. The device is adaptable to forced air floor, wall or overhead registers, outlets or diffusers.

[0007] U.S. Pat. No. 4,741,871 entitled "Free flow humidifier," the content of which is incorporated by reference herein describes a humidifier for use in combination with a hot air forced heating system. The humidifier consists of a main housing (water box) which maintains a constant water level from an existing water source and controlled by a float control valve. The water is heated by a hot water heating coil. Hot air is directed into, through, and back into the main hot air stream. During this process, the hot dry air picks up moisture, becoming saturated, which is returned and mixed in the hot air supply duct, providing humidity throughout the entire system. The amount of air and humidity can be controlled by the inlet dampers, which regulates the amount of air flowing through the humidifier.

[0008] U.S. Pat. No. 4,986,937 entitled "Central air duct scooper humidifier," the content of which is incorporated herein by reference describes an ultrasonic humidifier system which is mounted to an air duct of a heating system. A vibrator excites water within a reservoir so as to create a fog within a fog chamber. A panel directs air flow from an upstream furnace into the fog chamber for interaction of the air flow with the fog. This interaction increases the moisture content of the air flow so as to increase the humidity level thereof. Reed switches are provided to preclude vibration if the level within the reservoir is low and/or if no air stream is delivered from the furnace.

[0009] U.S. Pat. No. 6,850,698 entitled "Humidifier for use with source of heated air," the content of which is incorporated herein by reference describes a free-standing humidifier that is suitable for placement near a source of heated air. Optionally, the humidifier is placed over a floor register in a home. The humidifier has a main reservoir for holding water, a rod having a length sufficient to extend across the reservoir, and panels that support the rod. A disposable paper towel is draped over the rod and one end of the paper towel is inserted through an opening in the top of the reservoir into water in the reservoir. Air flowing from the source impinges upon the paper towel and picks up moisture from it. A supplemental reservoir can be used to automatically supply additional water to the main reservoir from a water line that has a valve controlled by a float which turns the valve on and off.

General Description

[0010] According to one aspect of the presently disclose subject matter there is provided a humidifying unit for a heating ventilation air conditioning (HVAC) system comprising a tray disposed at the airways of the HVAC system configured to hold water therein and for humidifying the air stream in the airways. The humidifying unit can be provided as a stand-alone apparatus for integrating in the airways of a HVAC, or can be integrally formed in the airways of an HVAC system.

[0011] The humidifying unit can be configured to be integrated or installed in a ductwork of a central HVAC system or in the airways of a single room unit such as ductless system, a split-system, window air conditioner or a portable system.

[0012] The humidifying unit can be provided with a humidity level by controlling the exposure of airstream to the water in the tray control which according to an example can be in the form of a moving lid disposed over the tray.

[0013] The humidifying unit allows a passive operation of introducing humidity into the air steam of the HVAC system by utilizing the kinetics of the air stream flowing in the airways thereof.

[0014] According to an example of the presently disclosed subject matter, the humidifying unit is integrated into an air handler of a ductless HVAC unit proximal to a vent through which air stream is pushed out. The humidifying unit can include a tray, channel and/or box for holding water. The tray can be integral to a frame of the vent in the air handler through which air stream is blown out. The frame of the air handler can

provide a dedicated space and/or base for positioning the humidifying unit. Optionally, frames of existing air handlers are modified to provide the dedicated space and/or base. The tray can further include one or more water inlets and/or outlets.

[0015] The humidifying unit can be operable to increase a humidity level of air stream outflow from the HVAC system during heating, ventilation and also during cooling. During heating, the hot air stream blown out of the HVAC system passes over the tray filled with water leading to evaporation. The inventor has found that since both the velocity of air flow and the temperature of the air stream is relatively high as it exits the vent, a relatively high rate of evaporation can be achieved by pacing the humidifying unit near the vent.

[0016] Optionally, while the HVAC system is operated in a cooling mode, e.g. air conditioning mode, water that is condensed during cooling is directed toward the tray and used to humidify the air stream outflow of the HVAC system. Although, the rate of evaporation is typically lower during cooling, the inventors have found that some water will be absorbed in the air stream. Optionally, while the HVAC system is operated in ventilation mode and the ventilated air is relatively warm and dry, HVAC system together with the humidifying unit can be operated as an evaporated cooling system to both cool and humidify the ventilated air.

[0017] According to another example of the presently disclosed subject matter, the humidifying unit is integrated into a grille and/or ductwork connector of a mini-duct or duct HVAC unit. The humidifying unit can include a tray for holding water that is integral to the grille or ductwork connector. As used herein the term ductwork connector refers to a part that used to connect duct tubing to a grille. The tray can include one or more water inlets and/or outlets through which tubing can be connected.

[0018] According to further examples of the presently disclosed subject matter, the humidifying unit is integrated into a main airflow duct channel of a central HVAC system and is operable to humidify the air stream outflow prior to splitting the air stream outflow to a plurality of different ducts.

[0019] According to a further aspect of the presently disclose subject matter there is provided a HVAC system having airways configured to direct airflow towards a confined area, the system comprising a humidifying unit having a tray disposed in the airways and configured to hold water therein, the tray is so disposed in said airways such that the water humidifies the airflow in said airways controlling thereby the humidity level in the confined area.

[0020] The water tray can be integrally formed with a wall portion of the airways. The airways can include a duct channel having a grille and wherein the water tray is integrally formed with said grille. The airways can include a ductwork connector and wherein the water tray is integrated therein.

[0021] The HVAC system can be a central air system having a central duct and the water tray can disposed in said duct.

[0022] The humidifying unit can include an adjusting mechanism for adjusting the surface area of the water exposed to the airflow in the airway. The adjusting mechanism can include a lid configured to be selectively disposed with respect to the tray determining thereby the surface area of the water exposed to the air in the airway.

[0023] The HVAC system can further include a controller for controlling the disposition of the lid in accordance with the desired humidity level. The HVAC system can include a water inlet line connected to the water tray via a water inlet port. The HVAC system can include a condensation drainer being configured to direct water from a condensation drain towards the tray. The controller can be operative to initiate filling of water in response to turning on of the HVAC system.

[0024] The tray can be provided with a drain line configured to drain the water inside the water tray. A controller can be provided and can be operative to initiate draining of water in the water tray in response to turning off of the HVAC system.

[0025] The adjusting mechanism can include a water level regulator configured to control the water level in the water tray thereby adjusting the surface area of the water exposed to the airflow in the airway.

[0026] The HVAC system can further comprise a heating element disposed in the water tray and configured to heat the water therein thereby accelerating humidification of the air in the airways. The heating element is a heated gas line of the HVAC system directed to the water tray for heating water in the water tray.

[0027] The HVAC system can further comprise a cleaning mechanism for removing calcification accumulating therefrom. The cleaning mechanism can include a brush for breaking up calcification accumulating in the water tray. The cleaning mechanism comprising a high pressure sprinkling rod operative to direct high pressure water toward in surface of the water tray for breaking up calcification accumulating in the water tray. The HVAC system can further comprise a wall portion disposed inside the airways, having a surface configured to allow water flow thereon form said tray. The wall portion can be a sloped wall and the tray can be at a top portion thereof, such that water from the tray can flow downwardly under gravitational forces towards a low portion of the wall.

[0028] The humidifying unit may be configured to have any of the following features:

[0029] a removable cover that can be partially and fully opened and/or closed to vary the exposure of water to the air stream and thereby alter the humidity level achieved with the humidity unit;

[0030] a mechanism for tilting the tray by varying degrees, thereby controlling the surface area of the water that comes into contact with the airstream;

[0031] A humidity sensor for sensing the humidity level in a room, the sensor being coupled to the humidifying unit which determines the exposure area of the water inside the airways;

[0032] A manual or automatic mechanism for halting of the humidifying unit when the HVAC unit is on the cooling mode thereof;

[0033] An adjusting mechanism for adjusting the exposure area of the water, thereby adjusting the humidity level in the air;

[0034] A filling mechanism for filling the tray in response to a water level therein below a predetermined threshold; the filing mechanism can be in configured to collect condensed water formed during cooling mode;

[0035] A draining mechanism for draining the tray in response to a water level therein above a predetermined threshold;

[0036] An auxiliary reservoir being in fluid communication with the tray and configured for despising thereto cleaning liquid;

[0037] The cleaning liquid can be configured to prevent bacteria accumulation or can be a scale cleaning liquid, or can include an odor elimination material.

BRIEF DESCRIPTION OF THE DRAWINGS

[0038] In order to better understand the subject matter that is disclosed herein and to exemplify how it may be carried out in practice, examples will now be described, by way of non-limiting example only, with reference to the accompanying drawings, in which:

[0039] FIGS. **1**A and **1**B are simplified schematic drawings respectively of a known air handler for a ductless HVAC unit and the air handler with a humidifying unit in accordance with some examples of the presently disclosed subject matter;

[0040] FIG. **2***is* a simplified schematic drawing of optional water supply and drainage features of a humidifying unit in an air handler of a ductless HVAC system in accordance with an example of the presently disclosed subject matter;

[0041] FIG. **3** is a simplified schematic drawing of a humidifying unit integrated into a grille extending from duct channel of an HVAC system in accordance with some examples of the presently disclosed subject matter;

[0042] FIG. **4** is a simplified schematic drawing of a humidifying unit integrated into a connector between a duct channel and grille of an HVAC system in accordance with some examples of the presently disclosed subject matter;

[0043] FIG. **5** is a simplified schematic drawing of a humidifying unit integrated with a central air HVAC system in accordance with some examples of the presently disclosed subject matter;

[0044] FIG. **6**A is a simplified schematic drawing of a HVAC system having a humidifying unit in accordance with another example of the presently disclosed subject matter;

[0045] FIG. **6**B is an exploded view of the HVAC system of FIG. **6**A;

[0046] FIG. **6**C is a side sectional view of the HVAC system of FIG. **6**A;

[0047] FIG. **7**A is a front perspective view of the humidifying unit of FIG. **6**A;

[0048] FIG. **7**B is an exploded view of the humidifying unit of FIG. **7**A;

[0049] FIG. **7**C is an enlarged view of the pumping mechanism of the humidifying unit of FIG. **7**A;

[0050] FIG. **7**D is an enlarged view of the adjusting mechanism of the humidifying unit of FIG. **7**A;

[0051] FIG. **8** is a simplified schematic drawing of a humidifying unit with an optional tilting feature in accordance with some examples of the presently disclosed subject matter;

[0052] FIG. **9**A is a side sectional view a folded cardboard in accordance with one example of the presently disclosed subject matter, disposed in a tray of a humidifying unit;

[0053] FIG. **9**B is a side sectional view of cardboard of FIG. **9**A;

[0054] FIG. **9**C is a side perspective view of the tray of FIG. **9**A;

[0055] FIG. **10**A is a top view of a cardboard in accordance with another example of the presently disclosed subject matter;

[0056] FIG. **10**B is a perspective view of a cardboard in accordance with another example of the presently disclosed subject matter;

[0057] FIG. **11**A is a side sectional view of an AC unit having a humidifying unit in accordance with another example of the presently disclosed subject matter; and,

[0058] FIG. **11**B is an enlarged view of the humidifying unit of FIG. **11**A.

DETAILED DESCRIPTION OF EXAMPLES

[0059] Reference is now made to FIGS. **1**A and **1**B showing simplified schematic drawings respectively of a known air handler for a ductless HVAC system and the air handler with a humidifying unit in accordance with some examples of the presently disclosed subject matter. A known air handler and/or evaporator unit **101** of a split ductless HVAC system typically includes a vent **110** through which conditioned air, e.g. heated, cooled or ventilated air is expelled and/or blown out. Typically, vent **110** is encompassed and/or defined by a frame **112** that is formed as part of a cover of air handler **101**. Typically, an array of directional blades **115** can be controlled to direct the air expelled through vent **110** in a desired direction, e.g. left or right. The vent **110** can be covered by a flap **120** that can be rotated to control the direction of air flow in a vertical direction, e.g. up and down. The flap **120** can be closed while air handler **101** is not in an operational mode, e.g. while air handler **101** is switched off.

[0060] According to some examples of the presently disclosed subject matter, there is provided a humidifying unit **150** that is integrated into an air handler **105** of an HVAC system. According to some examples of the presently disclosed subject matter, humidifying unit **150** is positioned in a vent **111**. Typically, frame **113** defining an extent of the vent **111** is enlarged as compared to frame **112** (FIG. **1**A) to accommodate humidifying unit **150**. In some examples, humidifying unit **150** is positioned below directional blades **115** and within frame **113**.

[0061] According to some examples of the presently disclosed subject matter, humidifying unit **150** includes a tray and/or water box **160** for collecting and/or holding water. Optionally, tray **160** includes one or more inlet and/or outlet ports through which water and/or other fluids can be introduced and/or drained from tray **160**. According to some examples of the presently disclosed subject matter, tray **160** is formed as part of frame **113**. Optionally, frame **113** is formed from with a polymer material by a molding process and tray **160** is molded as part of frame **113**. Alternatively tray **160** is a part distinct from frame **113** and is inserted into frame **113**. According to some examples of the presently disclosed subject matter, as air outflow **180** is expelled from air handler **105**, it skims the surface of water contained in tray **160** and becomes humidified, e.g. saturated with water vapor. In some examples, water supply for humidifying unit **150** is provided by a water supply tube **170** that optionally connects to a main water line or other water source, e.g. a tank. Optionally, water supply tube **170** is fitted with a safety valve **175** for cutting off water supply to tray **160**. Optionally, safety valve **175** is fitted within the housing of air handler **105**. Optionally, a filter is fitted in tube **170** for filtering water supply to tray **160**. Optionally, tray **160** is manually filled with water.

[0062] The tray **160** can be sized to extend over a substantially entire length of vent **111** so that air outflow **180** has adequate interface with water contained in tray **160**. The height of tray **160** can span between 1-5 cm and the depth of tray **160** can span between 1-5 cm, depending on dimensions of air handler **105**. The tray **160** can be sized to hold approximately 100-400 ml of water. Reference is now made to FIGS. **2**A and **2**B, water supply tube **170** can be provided and configured to supply water to tray **160** to maintain a desired level and/or volume of water within tray **160**. The water supply tube **170** can be associated with a valve **172** that can be controlled by controller **200** of humidifying unit **150** or a float valve in tray **160**. The valve **172** and safety valve **175** can be

integrated in a single module integral. In some examples of FIG. **2***b*, water from condensate drain tube **177** drains water via and/or to tray **160** so that condensate drain tube **177** can supply water to the tray **160** while the HVAC system is in a cooling mode. Optionally, a gas pipe in a condenser portion of the HVAC system is extended into tray **160** and used to warm the collected water.

[0063] The humidifying unit **150** can include a drain **175** for draining water out of tray **160**. Optionally, two drains **175** on opposite sides of tray **160** are used to avoid drainage problems due to an angle in tray **160**. The drain **175** can be connected with tubing **176** that typically directs condensed water formed during cooling to outside a building or home so as to allow evacuation of water from the tray. Alternatively, humidifying unit uses dedicated tubing to drain water out of tray **160** to a sewage line and/or outside a building or home. Typically drain **175** is associated with a valve **179** for controlling water flow out of drain **175** that can be operated by a controller **200** of humidifying unit **150**. The humidifying unit **150** can additionally include an overflow drain (not shown) which drains into condensate drain line **176**. It is appreciated that in case the HVAC system is not configured with a cooling mode, and thus does not provide condensed water, the system can be provided with a condensation apparatus, for example, from the outside ambient, so as to provide water into the tray.

[0064] It is noted that although humidifying unit **150** has been described in FIGS. **1**, **2**A and **2**B as being integrated into a split ductless HVAC system typically including a air handler inside of a room and a compressor positioned outside, a similar construction can be used for example in a single unit air conditioner, e.g. an air conditioning window unit.

[0065] Reference is now made to FIG. **3**, a humidifying unit can be integrated into a grille extending from duct channel of an HVAC system. According to some examples, the humidifying unit is integrated into ductwork of the HVAC system. A tray **260** of a humidifying unit **250** can be positioned and/or integrated onto a grille and/or register **210** positioned on a wall of a room, e.g. a wall of a dropped ceiling. As air outflow **280** blowing out from grille **210**, e.g. in a generally horizontal direction it skims the surface of water contained in a tray **260** of humidifying unit **250** and becomes humidified, e.g. saturated with water vapor. In some examples, tray **260** is integral to grille **210** and includes one or more water outlet and/or inlet ports for receiving and/or draining water into tray **260**. Optionally, grille **210** is molded with a cavity defining tray **260**. Optionally, a depth of grille **210**, e.g. it dimension going into the wall is increased relative to known dimensions of grilles to accommodate tray **260**. Optionally, tray **260** is a separate part that is fastened onto grille **210** during manufacturing. Typically tray **260** extends over a length of a vent opening of grille **210** and is typically interior to direction blades of grille **210** so that it is concealed. In some examples, both height depth of tray **260** ranges between 0.5-3 cm, although dimensions of tray **260** typically vary with size of grille **210**. Optionally, for ceiling grilles, tray **160** is integrated into the direction blades of the grille.

[0066] The water supply to tray **260** can be provided by a water line **270**. Optionally water line **270** connects to a water source, e.g. a main water line and water line **270** that extends through duct tubing **220** to tray **260**. Alternatively, water line **270** can be positioned outside of duct tubing **220** and is connected to tray **260** via a port in tray **260** (not shown). The water can be filled by manually filing tray **260**. According to some examples of the presently disclosed subject matter, a drain **275** with drain line **282** connects to tray **260** for draining water from the tray when required. Typically, drain **275** with drain line **282** is associated with a valve for controlling draining. Optionally, drain line **282** is directed toward a sewage line of the premises or is otherwise drained outdoors. Optional features of humidifying unit **250** are described in more details herein in reference to FIGS. **6-8**.

[0067] Reference is now made to FIG. **4** showing a humidifying unit **350** integrated into a connector between a duct channel and grille of an HVAC system in accordance with some examples of the presently disclosed subject matter. The tray **360** of a humidifying unit **350** is positioned and/or integrated into a ductwork connector **310** between a duct channel **320** and grille **310** of an HVAC system, where at least a portion of the ductwork connector is positioned horizontally, e.g. parallel to a dropped ceiling. Optionally, grille **310** is a wall grilled. Alternatively, a ceiling grille that directs air flow from a generally horizontal duct channel **320** downwards in a generally vertical direction is used.

[0068] Typically, tray **360** is positioned so that walls of the tray do not obstruct air flow **380** blowing through connector **310**. Optionally, walls of tray **360** are insulated to avoid condensation on outer walls. As air outflow **380** blows out through grille **310** in a horizontal direction it skims the surface of water contained in tray **360** of a humidifying unit **350** and becomes humidified, e.g. saturated with water vapor. The tray **360** can be integral to connector **310** and includes water outlet and/or inlet ports for receiving and draining water into tray **360**. Optionally, connector **310** is molded with a cavity defining tray **360**. Optionally, tray **360** is a separate part that is fastened onto connector **310** during manufacturing and/or assembly. Optionally, tray **360** is sized to substantially extend over a diameter of duct tubing **320**. Optionally, tray **360** is sized to substantially extend over a length of connector **310**. Optionally, the depth of tray ranges between 1-5 cm although its depth will typically vary with different sizes of duct connectors and/or duct tubing and can be deeper than 5 cm.

[0069] The water supply to tray **360** can be provided by a water line **370**. Optionally water line **370** connects to a water source, e.g. a main water line and water line **370** extends through duct tubing **320** to tray **360**. Alternatively, water line **370** is positioned outside of duct tubing **320** and is connected to tray **360** via a port in tray **360** (not shown). in addition, a drain **375** can be provided and can include drain line **382** connected to tray **360** for draining water from the tray when required. Typically, drain **375** with drain line **382** is associated with a valve for controlling draining. Optionally, drain line **382** is directed toward a sewage line of the premises or is otherwise drained outdoors. Optional features of humidifying unit **350** are described in more details herein in reference to FIGS. **6-8**.

[0070] Reference is now made to FIG. **5** showing a simplified schematic drawing of a humidifying unit **450** integrated with a central air HVAC system in accordance with some examples of the presently disclosed subject matter. A tray **460** of a humidifying unit **450** is positioned and/or integrated onto a main duct line **420** of the central HAVC system prior to the air flow splitting into plurality of duct lines **421**, **422**, **423** and **424**. Optionally, tray **460** is sized to substantially extend over a diameter of main duct tubing **420**. A water supply to tray **460** can be provided by a water line **470** and is drained with a drain line **482**. Optional features of humidifying unit **450** are described in more details herein in reference to FIGS. **6-8**.

[0071] Reference is now made to FIG. **6**, a humidifying unit **550** can be integrated in a wall mounted AC unit **500** having a cooling unit **510** and a cover **512** defining an air outlet aperture **514**. As shown in FIGS. **7**A and **7**B, the humidifying unit **550** includes a tray **560** and a pumping mechanism **570** for supplying the tray **560** with water. The pumping mechanism **570** can be configured to pump water from a reservoir **555** coupled to the AC unit **500**.

[0072] As shown in FIG. **7**C the pumping mechanism **570** can include a pump **572** which is configured to pump liquid, such as water, form the reservoir **555**. According to the illustrated example the pump **572** is coupled to an auxiliary reservoir **574** via a pipe **575**, which can include a cleaning liquid, and which is coupled to the reservoir **555**. This way, the pump draws water from the reservoir **555** as well as cleaning liquid from the auxiliary reservoir **574**. The cleaning liquid can be any known liquid configured to prevent bacteria accumulation inside the tray **560**, or can be a scale cleaning liquid, or odor elimination material. In addition, the cleaning liquid can include other additives for purifying the air in the room, smell additives, or other chemicals which it is desired to spray in the room.

[0073] It is appreciated that the tray can be provided with a sensor for sensing the quality of the water therein, such that the pump can be activated to draw cleaning liquid from the auxiliary reservoir **574** in response to low quality water in the tray.

[0074] According to an example the tray can be removable tray such that it can be periodically removed and cleaned.

[0075] According to an example, the tray can be formed form a scale resistant material.

[0076] It is appreciated that according to an example the tray can be disposed with respect to the airflow, such that dust in the air can be collected by the water surface, such that the water facilitate in cleaning the air.

[0077] According to an example the pump is coupled to an electric valve **578** which is configured to provide water to a dripper element **580**. The dripper element **580** is configured to release a small stream of water, or drips of water into the tray **560**. The electric valve **578** can be configured to control the operation of the pump and to dictate the amount of cleaning liquid which is released. The pumping mechanism **570** can be encased in a housing **582** provided with a door **584**.

[0078] According to an example, the pumping mechanism **570** further includes a draining pump **576**, coupled to the tray **560** via a pipe **562**. The draining pump is configured to draining the water in the tray, and it can be coupled to a swage system, or can be coupled to a pipe which can be used to direct the drained fluid into a bowl upon the need. The draining pump can be activated to drain water from the tray, when the temperature of the water rises above a predetermined threshold, for example to a level which does not allow proper humidification of the airstream. In the latter case the pumping mechanism **570** can be configured to provide fresh water to the tray so as to allow continuous humidification of the airstream.

[0079] The tray **560** can be provided with an adjusting mechanism for adjusting the exposure area of the water, thereby adjusting the humidity level in the air. The adjusting mechanism can include removable lid **505** configured to selectively open and close in response to the humidity level in the room. The removable lid can be provided with an actuating mechanism **530**.

[0080] Reference is now made to FIG. **7**D, the actuating mechanism **530** can include a motor **531** having a cog-wheel **532** mounted thereon configured to engage a corresponding cog-wheel **524** on which the lid **505** is mounted. When the motor **531** is activated the cog-wheel **532** is rotated in one direction causing the corresponding cog wheel **524** and the lid **505** to turn in the opposite direction. The lid **505** according to this example is configured as a semi-circular cover, such that in response to rotation of corresponding cog wheel **524** the lid **505** rotated about the tray **560**. This way, the disposition of the lid **505** with reference to the tray **560** can be determined and so does the surface area of the water which is exposed to the air in the airway of the AC unit.

[0081] It is appreciated that the corresponding cog-wheel **524** can defined teeth **526** only about a portion of the circumference thereof. This way when the motor **531** is rotated and the teeth of the cog-wheel **532** engage teeth **526**, the corresponding cog wheel **524** and the lid **505** are rotated as well. As the teeth of the cog-wheel **532** reach the area on the circumference of the corresponding cog wheel **524** which does not include teeth the rotation of the corresponding cog wheel **524** and the lid **505** stops. Thus, the amount of teeth on the corresponding cog wheel **524** determines the maximum rotation of the lid **505**, and precludes damage thereto, when fully closed or fully opened.

[0082] In some examples, a heating element (not shown) is introduced into tray **560** for heating and/or sterilizing water in the tray. Optionally, the heating element can be operated to boost evaporation of water in tray **560**. The tray **560** can be fitted with a removable lid **505**. The humidity level provided by the humidifying unit can be controlled by controlling position of removable lid **505**. The controller can be configured to partially close removable lid **505** to reduce the humidity level provided by humidifier **550**. Optionally the controller can fully close the removable lid **505** while the AC unit **500** is not operated, e.g. is turned OFF so that the water and/or tray remains clean while not being used. Optionally, a humidity sensor (not shown), e.g. a hygrometer is used to detect a humidity level in room and to provide input to controller for controlling a humidity level provided by humidifying unit **550**. The humidity sensor can be positioned in a air handler, near a thermostat of the AC unit **500** and/or anywhere in a room that is being heated or cooled.

[0083] According to another example the adjusting mechanism can include a water level regulator configured to sense and control the water level in the water tray thereby adjusting the surface area of the water exposed to the airflow in the airway.

[0084] The tray **560** can be installed with one or more mechanisms for breaking up calcification that can accumulate on inner surfaces of tray **560**. Optionally, a brush (not shown) can be provided for removing scale from the tray and can be disposed in the tray such that it touches the floor thereof. The brush can be operated with a piezoelectric element that vibrates and/or motor that moves brush so that it breaks up accumulated calcification. Alternatively, a high pressure sprinkling rod can be fluidly connected to a water supply line and high pressurized water expelled from a sprinkling rod provides for breaking up accumulated calcification, on walls and floor of tray **560**. The tray **560** is installed with a basket (not shown) that is operable to hold a tablet for softening, disinfecting and/or adding fragrance to the water in tank **560**. Optionally, the basket can include a removable cover that can be used controllably expose the basket to water in tank **560**.

[0085] The tray can further be provided with means for stirring the water, for example a small turbine coupled to a motor, a flow generator inside the tray, or a pump, this way the top surface of the water is constantly stirred and the heating of the water surface is mitigated. It is appreciated that maintaining the temperature of the water surface below a certain threshold can help the humidifying process of the airstream. The turbine can be activated only in response to a rise in the temperature of the water surface in the tray. According to another example the turbine can be activated so as to reduce the evaporation of the water in the tray.

[0086] A draining pump **576** can be provided and can be operable to initiate draining of tray **560** in response to sensing that theca unit has been turned off. Optionally, the controller is operable to initiate cleaning of tray **560** with the brush and/or sprinkler rod in response to sensing that the AC unit **500** has been turned off. Optionally, controller is operable to initiate filling of tray **560** with water in response to detecting that the systemic unit has been turned on and/or in response to input from a humidity sensor. Optionally, the tray is slanted so that calcification is localized near drain.

[0087] According to some examples of the presently disclosed subject matter, the cover can be rounded and can be formed from one or more blades that can be collapsed to open cover to varying extents, e.g. partially or fully.

[0088] Reference is now made to FIG. **8** showing a tray **560** in accordance with another example. The tray **560** is supported with by an axle **513** that can be rotated to tile tray **560** to a desired angle. Optionally, a motor communicates with axle **513** for rotating the axle. Optionally, different tilt angles are used to control the humidity level provided by humidifying unit **550**. Optionally, tilting tray **560** provides for changing the surface area of the water in tray **560** and thereby changing humidity level provided by humidifying unit **550**. Typically a larger surface area provides increased humidity while a smaller surface area provides decreased humidity. Optionally, tilting tray **560** away from air flow reduces the humidity level provided or stops the humidifying action while tilting tray **560** toward the air flow increases the humidity level provided by humidifying unit **550**. Optionally, the tilting feature is used in place of the lid. In the previous examples the humidifying systems is configured to provide a contact between the passing air and a surface of water disposed inside the ventilation system thereby humidifying the air. It will be appreciated however, that the amount of moisture transferred from the water to the air is proportional to the area of contact surface between the air and the water. Accordingly, in order to achieve sufficient air humidity in the room, the contact area can be increased, beyond the dimensions of the tray of the humidifying systems.

[0089] According to an example increasing the surface area can be carried out by utilizing a porous hydrophilic material, such as a cardboard, for significant increase of the contact area of passing air with water.

[0090] Reference is now made to FIG. **9**A, a tray **605** can be configured to hold water **606** therein, together with a folded cardboard **600**. The cardboard **600** is configured to absorb water **606** therein, and due to the folding thereof it can define a large surface area, thus increasing the surface area of water particles with the air. It is appreciated that folding of the cardboard **600** is configured such that on one hand water can be absorbed therein and on the other hand air form the HVAC system can flow through the gaps **607** formed between the folds. The cardboard **600** can be disposed inside the tray **605** such that the folds are perpendicular to the direction of the airflow in the HVAC system, such that the air flows through the gaps **607** formed therebetween.

[0091] To improve water transfer, a variety of cardboard can be selected having wetting ability and at the same time maintaining rigidity in wet condition. It is also possible to add a certain detergent to the water, which would increase the wetting and improve the transfer of moisture.

[0092] As shown in FIG. **9**B, the cardboard **600** can includes an inner layer **602**, and outer layer **604** and a corrugated layer **603** disposed therebetween configured to provide capillary water transfer therethrough.

[0093] According to another example, as shown in FIG. **10**A, the cardboard **630** can be provided with a plurality of apertures **635**, such that air can flow therein contacting thereby more surfaces of cardboard and accumulating humidity thereby.

[0094] According to a further example, as shown in FIG. **10**B, the cardboard **640** can be provided with a plurality of apertures **642**, provided at the top portioned of each fold such that air can flow through the top portion of the cardboard **640**, contacting thereby more surfaces of cardboard and accumulating humidity thereby.

[0095] It is appreciated that other techniques form improving humidifying of the water can be utilized such as heating and evaporating portion of water or applying ultrasound waves for forming water particles.

[0096] The tray according to other examples can be filled with ice powder or pulverized or powder-like ice can also cool air.

[0097] As shown in FIGS. **11**A and **11**B, according with a further example an AC unit **670** can be provided with a humidifying unit **680** configured to provide fluids flow, such as water, along a wall **682** disposed inside the air duct. The wall **682**, here illustrated as sloped wall can alternatively be a vertical or a, such that water provided on a top portion thereof, flow downwardly under gravitational forces towards a low portion thereof. It is appreciated that the wall **682** can be one of the inner walls of the airway of the AC unit.

[0098] The water can be provided on the wall **682** by forming a water channel **681** at the top portion of the wall **682**. The channel **681** is configured such that when water therein overflow, the water spill onto the wall downwardly. This way, the exposure area of the air to the water is not only the area of the tray, rather it is the area of the wall **682** on which water are provided.

[0099] Thus, the channel **681** can be defined along the entire length of a wall portion which in the airway of the AC unit, such that all the air flowing inside the AC unit is exposed to the water on the wall and humidity is accumulated in the air. The level in the water tray can be maintained such that water overflow towards the wall when the humidity level of the room falls below the desired level. This can be carried out for example by providing a tray **685** having water **675** therein, and a pump **690** providing fluid communication between the tray **685** and the channel **681** by means of pipe segments **692***a* and **692***b*. The pump **690** can be configured to pump water onto the channel **681** when the humidity level drops below the desired level.

[0100] The humidifying unit **680** can further be provided with a draining mechanism for draining any redundant water at the bottom of the wall portion **682**. According to the illus-

trated example the draining mechanism is a slit **695** defined along the length of the wall, underneath which the tray **685** is disposed.

[0101] According to an example, the humidifying unit can be a slit **695** provided with water therein, for example by disposing a water tray underneath. The slit **695** can be disposed along the entire width of the airway, and the can disposed at the bottom of the wall portion **682**, or along nay other point of the wall portion, which is illustrated here as a sloped wall portion. It is appreciated that according to this example, the wall portion **682** is not configured to allow water flow thereon, rather the inventor has found that defining a slit **695**, or a similar channel on the sloped wall or at the bottom thereof, enhances the humidification process.

[0102] It is appreciated that the humidifying unit of the presently disclosed subject matter substantially does not consume energy however merely operate by utilizing the kinetics of the air stream flowing in the airways thereof. The humidifying unit can be provided with an energy source for operating the adjusting mechanism and such that the disposition of the cover is manipulated, or for operating the pump providing the water into the tray.

[0103] It is appreciated that in addition, to the above, utilizing the humidifying unit substantially eliminate the need to open the window so as to adjust the humidity level in the room, thus the presently disclosed humidifying unit reduces the energy consumption of the HVAC system.

[0104] When hot air flows through the air duct, the water along the wall raise the humidity level of the air.

[0105] It is appreciated that the dimensions of the wall, such as the length and the width thereof determine the exposure of the air inside the air duct to the water, and the humidity formed thereby.

[0106] According to an example the wall can be a horizontal wall, the water can be provided on one side thereof by sprinklers, the airflow urges the water to flow along the wall.

[0107] According to other examples, the water can be provided by means of sprinkles configured to sprinkle water on the top of the wall, thereby causing the water to flow downwardly.

[0108] It is noted that although most of the examples of the presently disclosed subject matter have been discussed in reference to home and/or building HVAC systems, the humidifying units described herein can also be used and/or adapted for use in HVAC systems in vehicles, such as cars, trains, busses and aircrafts.

[0109] In addition, the humidifying units can be integrated in any A/C system such as air curtains, air conditionings, evaporative Cooling Units, and humidifiers. Etc. The terms: "comprises", "comprising", "includes", "including", "having" and their conjugates mean "including but not limited to."

[0110] As used herein, the singular form "a", "an" and "the" include plural references unless the context clearly dictates otherwise. For example, the term "a compound" or "at least one compound" may include a plurality of compounds, including mixtures thereof.

[0111] It is appreciated that certain features of the subject matter, which are, for clarity, described in the context of separate examples, may also be provided in combination in a single embodiment. Conversely, various features of the subject matter, which are, for brevity, described in the context of a single embodiment, may also be provided separately or in any suitable sub-combination or as suitable in any other described embodiment of the subject matter. Certain features described in the context of various examples are not to be considered essential features of those examples, unless the embodiment is inoperative without those elements.

1. A humidifying unit for a heating ventilation air conditioning (HVAC) system, comprising: a tray configured to be disposed at the airways of the HVAC system and configured to hold water so as to humidify the air stream in the airways.

2. (canceled)

3. The humidifying unit according to claim **1**, wherein the tray is integrally formed with a grille of a duct channel of a HVAC system.

4. (canceled)

5. (canceled)

6. The humidifying unit according to claim **1**, further comprising a lid configured to be selectively disposed with respect to the tray thereby determining surface area of water exposed to the air in the airway.

7. The humidifying unit according to claim **6**, further comprising a controller for controlling the disposition of the lid in accordance with the desired humidity level.

8. (canceled)

9. (canceled)

10. (canceled)

11. (canceled)

12. (canceled)

13. The humidifying unit according to claim **1**, further comprising a heating element disposed in the tray and configured to heat the water therein thereby accelerating humidification of the air in the airways of the HVAC system.

14. The humidifying unit according to claim **13**, wherein said heating element is a heated gas line of the HVAC system directed to the tray for heating water in the tray.

15. (canceled)

16. (canceled)

17. (canceled)

18. The humidifying unit according to claim **1**, further comprising a basket operative to hold a tablet in fluid communication with water in the tray for disinfecting or softening the water in the water tray.

19. The humidifying unit according to claim **1**, wherein the tray is supported on an axle configured to be rotated for tilting the tray.

20. (canceled)

21. The humidifying unit according to claim **1**, wherein the tray further comprises folded surfaces comprising hydrophilic cardboard comprising a corrugated layer, the corrugated layer configured to provide capillary water transfer.

22. A HVAC system having airways configured to direct airflow towards a confined area, the system comprising a humidifying unit comprising a tray disposed in the airways and configured to hold water therein, the tray is so disposed in said airways such that the water humidifies the airflow in said airways thereby controlling the humidity level in the confined area.

23. The HVAC system according to claim **22**, wherein the tray is integrally formed with a wall portion of the airways.

24. (canceled)

25. (canceled)

26. The HVAC system according to claim **22**, wherein the HVAC system is a central air system having a central duct and wherein said tray is disposed in said duct.

27. The HVAC system according to claim **22**, wherein said humidifying unit further comprises an adjusting mechanism for adjusting the surface area of the water exposed to the airflow in the airway.

28. (canceled)

29. (canceled)

30. The HVAC system according to claim **22**, further comprising a water inlet line connected to the tray via a water inlet port.

31. (canceled)

32. (canceled)

33. The HVAC system according to claim **22**, wherein said tray is provided with a drain line configured to drain the water inside the tray.

34. (canceled)

35. (canceled)

36. The HVAC system according to claim **22**, further comprising a heating element disposed in the tray and configured to heat the water therein thereby accelerating humidification of the air in the airways.

37. (canceled)

38. The HVAC system according to claim **22**, further comprising a cleaning mechanism for removing calcification accumulating therefrom.

39. (canceled)

40. (canceled)

41. The HVAC system according to claim **22**, further comprising an auxiliary reservoir in fluid communication with the tray and configured for dispensing a cleaning liquid to the tray.

42. (canceled)

43. (canceled)

44. (canceled)

45. (canceled)

46. (canceled)

47. The HVAC system according to claim **22**, further comprising a wall portion disposed inside said airways, the wall portion having a surface configured to allow water flow thereon from said tray.

48. (canceled)

49. (canceled)

50. A method for humidifying air directed out of a HVAC system to a confined area, the method comprising:

disposing a water tray inside the airways of the HVAC system such that water therein humidifies the airflow in said airways thereby controlling the humidity level in the confined area; and

forming an adjusting mechanism for adjusting the surface area of water exposed to the airflow in the airway.

* * * * *